Mathematics through MOVEMENT

An investigation of the links between kinaesthetic and conceptual learning

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describes how she used dance and movement to engage students in mathematical investigations.

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Developing strategies for engaging mathematics activities is always a challenge. Teachers seek out new resources and online activities to excite students and support their learning. Mathematics through Movement offers an active learning strategy requiring few resources, and a bit of imagination, to achieve a variety of outcomes across mathematics domains. It is based on sound educational theory and a life time of experience in dance. This paper examines the beginnings of research into this teaching strategy in a remote setting in Western Australia. It shows that this teaching tool can motivate talk, deepen understandings, and engage students in mathematics tasks.

Background

As a dancer, teacher of dance and mother, I had often reflected upon the significant role movement had in my life and that of my daughters. Dancers, dance teachers and parents had often commented that dance, callisthenics or movement of some sort, had supported students in their school work. As a teacher I pondered on Gardner's kinesthetic learner and I am drawn to his statement: "Indeed participation in the arts is so natural and integral a part of human growth that an understanding of this process should provide

important clues to many pivotal questions of human development," (Gardner, 1973, p. 23).

Observation of my classroom in northern Western Australia, in a small rural town, showed that students were more engaged with ideas and learning if there was an element of movement involved. Many seemed to be kinaesthetic learners. This prompted the use of interactive technology but also a deeper investigation of how I could use my understanding of movement to enhance some core mathematical concepts. The links seemed obvious in my mind but could I show a direct educational benefit for integration of dance with specific mathematics foci?

Informal action research was undertaken in my classroom and anecdotal notes, video recordings and reflective journal entries gathered. The data were showing that some core mathematical concepts could be clarified and new ideas scaffolded using movement, especially in the Shape domain. This raised questions regarding how effective dance might be in supporting learning in the other mathematics domains, (Number, Measurement, Chance and Data). A program of learning was devised with dance as the core strategy that addressed all mathematics domains and their links to movement (see Figure 1).

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Outcomes	Shape	Measurement	Number	Chance and Data
Level 1 M11.1 The student: Makes non-numerical estimates of size involving everyday activities and actions. C&D 12.1 The student: Shows some recognition of the element of chance in familiar daily activities and uses and responds to the familiar everyday language of chance. S 15c.1 Represent transformations The student: Repeats, reorients and turns over things when matching shapes and making pictures and patterns. S16.1 The student: Talks about likenesses and differences between things that can be seen or handled and begins to connect shape, movement and function	Activity – Shape Bags/Body bags Exploring shape and movement	Activity – Space and Movement Estimating how much space the body or movements take up. Activity – Size when staging a dance.	Activity – Counting the beat. Activity – Rhythm and beat – looking at fractions when dancing.	Activity – Probability. Likelihood of achieving the same things in movement – skills and ability and chance.

Figure 1. Initial planning for Mathematics through Movement.

This paper will discuss the findings of that informal research, the testing of the initial outcomes in a new classroom with students with different learning styles and socio-economic backgrounds, and further developments that were derived from the program outlined in Figure 1.

Findings

The following data were derived from observing students in a K–3 cohort of predominately indigenous Australian decent, around 25–27 students at any time, in a small remote township in Western Australia. During 2006, mathematics concepts were integrated into the classroom program using the following outlined in Figure 2.

The results from using the above strategies will be discussed using the categories, Engagement, Deeper Understandings, Contextual Understandings and Fostering Talk.

Engagement

A primary result noted was the greater engagement of students with a learning task. The movement gave the tasks an element of fun and the students' enjoyment was very obvious in photographs and video tapes of the various activities. The nature of the tasks

Theme	Strategy	Purpose	DET Outcomes
Aliens	Elastics Square Dance Stretch Bags	To explore characteristics of 2D shapes. Understanding of a square and fractions of a square Investigate 3D shape Counting Doubling	S 15b.2 Represent shape The student: Meets simple criteria relating to shape or structure when making and drawing things, creating recognisable copies of arrangements of shapes. N 6b.2 Understand fractions The student: Understands the meaning of "half" and "quarter", splitting quantities into "equal" shares and partitioning quantities repeatedly into halves. Number Students use numbers and operations and the relationships between them efficiently and flexibly
Motorbikes	March formations Stagecraft	Spatial awareness, conforming to shape Directionality, Language	S 15a.3 …uses order, proximity and directional language associated with quarter and half turns on maps and in descriptions of locations and paths. S 15a.1 Represent location The student: Uses and interprets familiar, everyday language for the position of things, their movements and paths between them.

Figure 2. Further planning for Mathematics and Movement.

also made the students see that they could achieve the aims of the activities and therefore they were more easily engaged. For example, the students knew in the Square Dance that they could learn a series of simple steps to music and that the task was complete at the end of the music. They easily understood the directions to move in and the shapes they were creating when moving. This made the mathematics less confronting and more purposeful and the students responded accordingly. Since the students were highly engaged in the activities, the potential to learn was greatly heightened. This was shown in later discussions whereby children responded enthusiastically to questions about the task. The engagement of the students facilitated the next result, fostering talk.

Fostering talk

Talk is a very important aspect of the learning environment (Wood, 2003). Discussion, after movement activities, was enthusiastic and led to in depth talk about the core concepts. This was particularly so with the Stretch Bag strategy. The students were very interested in the movements and the shapes created and it was a favourite "free time" activity for the students after it was introduced into the program. This activity led to discussions regarding 2D and 3D shapes, including the characteristics of various regular and irregular polygons and how to transform shape. The use of this movement activity allowed for the demonstration all 3 aspects of Bruner's levels of representation, Enactive, Iconic, and Symbolic (Frid, 2001). Bruner contends that by using these modes of knowledge the student is scaffolded to new understandings since the learner is engaged in all aspects of the cognitive system. In this case, the children were actively involved with the concept of shape, making the shapes physically themselves (enactive mode). There were many opportunities to view shape both in a 3D contextual form and in visual representations (iconic) and, finally, due to the engaging discussion there were very powerful language based representations (symbolic).

Contextual understandings

During the Square Dance activity the students were able to use counting and number sense in a specific, purposeful context. The activity was designed to highlight the concept of doubling numbers, in this case doubling 8. Counting was emphasised whilst dancing and later discussion centred on how many counts it took to complete sections of the dance. The correlation and comparison was then drawn to doubles. On this occasion, the understanding of the new concept was not immediate, however there was a very useful reference point created when the concept was discussed in later more explicit teaching regarding the idea of doubling. By placing the concept in a context, I was able to scaffold the students' learning towards new ideas.

A very useful investigation that evolved out of the square dance was the directionality of the dance. The students travelled around the square but also did so diagonally across the square. By representing this diagrammatically the students were led, very easily, into the concept of fractions. A natural progression to cutting half sandwiches and quarters in fruit followed and the students were engaged with, and easily stepped towards understanding, a new concept.

Deeper understandings

By using the above strategies, I was able to give purpose to the students' learning. They did not learn a square had 4 sides by saying it over and over again. They knew because they moved around a square, they created one using the elastic (not as easy as it seems), and had to really think about a square and its attributes when doing so. I found this led to deeper understandings and longer term retention of information. By learning through doing, the students gained a thorough grasp of the target understandings.

Summary

This research has shown me that there is an important link between constructivist learning theory, the arts and human development, and learning by doing. My investigation is continuing and I find new and exciting evidence for Mathematics through Movement, with every session I conduct. Current work is showing that by allowing students to become the artistic critics (Gardner, 1973, p. 26) — that is, cultivating their ability to discern features and distinctions — they are able to communicate their understandings very effectively, thereby allowing a more accurate assessments of understandings to be made. The data above were a starting point for my research and, importantly, have led to reviewing literature, a greater attention to theoretical preface for chosen strategies, and more reliable data for future discussions.

There is, however, enough to suggest a few general applications for classroom practitioners. I should add, at this point, that a teacher need not have a huge knowledge of dance and complicated dance routines to implement a program such as that which I have described. I have used very simple and accessible dances, such as the square dance, to good effect. The challenge is to think laterally and find the place where movement fits in. For example, a new project in my classroom is "Happy Wheat" where the students are learning a simple tap dance routine to insert in their story about wheat in their home town of the wheat belt of WA. There are many forms of dance that can be investigated such as Aussie Bush dances, Social dances such as the "Nutbush" disco line dance, and creative movement with such things as the stretch bag. Finding links to your context will make the strategy more effective and engaging.

Mathematics through Movement offers an interesting and engaging strategy to achieve the vast outcomes that make up Being Numerate. By integrating a well thought out movement strategy, a teacher can achieve many outcomes at once. Mathematics through Movement provides rich tasks that, although seemingly closed in format, offer vast flexibility via discussion as to where an investigation may lead. This important reflective aspect of the process attends to the notion that "it is not sufficient simply to have an experience to learn" (Gibbs, 1988, p. 9).

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